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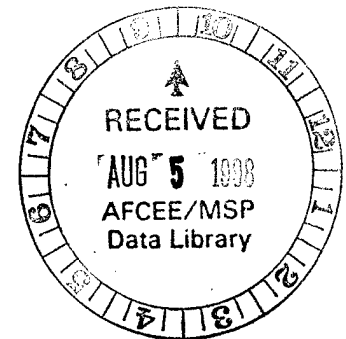
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PARSONS

Parsons Engineering Science, Inc.

1700 Broadway, Suite 900 • Denver, Colorado 80290 • (303) 831-8100 • Fax: (303) 831-8208

4 August 1998



Ms. Deb Soper
SM-ALC/EMR
5050 Dudley Blvd. Suite 3
McClellan AFB, California 95652-1389

Subject: Results of Soil Vapor Sampling at SA 6, McClellan Air Force Base,
California
(Contract No. F41624-92-D-8036, Order 17)

Dear Ms. Soper:

This letter presents the results of the soil vapor sampling performed by Parsons Engineering Science, Inc. (Parsons ES) on 11 March 1998 and 22 May 1998 at Study Area 6 (SA 6), McClellan Air Force Base (AFB), California. Soil vapor samples were collected by Parsons ES to assess the effectiveness of more than 4 years of bioventing in remediating the volatile organic compound (VOC) and total petroleum hydrocarbon (TPH) contamination in site soil. The soil vapor sampling event was performed in accordance with the *Final Sampling and Analysis Plan to Support Recommendation for No Further Investigation at SA 6* (Parsons ES, 1998) which has been reviewed and approved by the Air Force Center for Environmental Excellence (AFCEE), McClellan AFB, and the California Regional Water Quality Control Board, Central Valley Division. The SAP provides a detailed site description and history for SA 6 as well as soil and soil vapor sampling procedures and criteria to be used to support a no further investigation (NFI) recommendation. The purpose of this letter is to summarize the soil vapor sampling results and provide recommendations for confirmation soil sampling based on these results. A site layout illustrating soil vapor sampling locations and proposed soil sampling locations (Figure 1) and a table summarizing soil vapor results (Table 1) are attached.

SOIL VAPOR RESULTS

Soil vapor sampling was performed on 11 March 1998 following more than 1 month of bioventing system shutdown at SA 6 and again on 22 May 1998 following a 30-day shutdown of both the bioventing system and a soil vapor extraction (SVE) system at Investigation Cluster 7 (IC 7), a site adjacent to SA 6. In accordance with standard procedures, the bioventing system at SA 6 was shut down at least 1 month prior to the March 1998 sampling event to allow site soil and soil vapor to return to equilibrium conditions and allow comparison with previous soil vapor results. However, during the March 1998 sampling event, 2- to 3-inches of water vacuum were measured at several vapor monitoring point (VMP) screened intervals, indicating that the soils and soil vapor at SA 6 may be influenced by SVE system operation at IC 7. The SVE system at



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IC 7 was shut down on 22 April 1998 to ensure static/equilibrium conditions for the May 1998 soil vapor sampling event.

During the March and May 1998 sampling events, soil vapor samples were collected from the vent wells (EW279 and EW280) and the VMPs (VMP1, VMP2, and PZ91) at SA 6 in accordance with procedures described in the SAP (Parsons ES, 1998). Samples were field-screened to assess soil vapor concentrations of oxygen, carbon dioxide, total volatile hydrocarbons (TVH), and ionizable compounds. Samples from the VMPs also were submitted for laboratory analysis of total petroleum hydrocarbons referenced to gasoline (TPH-g) and benzene, toluene, ethylbenzene, and xylenes (BTEX) by US Environmental Protection Agency (USEPA) Method TO-3. Table 1 summarizes field soil vapor results and laboratory-determined concentrations of petroleum hydrocarbons in site soil vapor from the 1998 and previous sampling events.

Field measurements of static soil vapor concentrations as determined during the May 1998 sampling event generally indicate that site soils have been effectively remediated during more than 4 years of bioventing system operation at SA 6. Field measurements from the March 1998 sampling event, when soils at SA 6 were under the influence of the SVE system at IC 7, are not available. During the May 1998 sampling event, static oxygen concentrations in site soil vapor were at, or near, atmospheric levels (20.9 percent) and TVH, carbon dioxide, and photoionization detector (PID) measurements indicated little remaining VOC and TPH contamination at EW279, EW280, and most VMP screens greater than 40 feet below ground surface (bgs). The highest concentrations of TVH (250 parts per million, volume per volume [ppmv]) and ionizable compounds (47.5 ppmv) and lowest static oxygen concentration (3.9 percent) were measured at the 19.5-foot depth interval of VMP2 (VMP2-19.5). Static oxygen concentrations also were somewhat depleted at VMP2-30 (6.4 percent) and PZ91-24 (13.9 percent), but sufficient to support aerobic biodegradation of the low-level contamination which remains at these locations. The vapor sample from VMP1-17 was not field-screened because of the presence of water in the vapor sample.

Analytical soil vapor results from the March 1998 sampling event suggest that the SA 6 soils were influenced by SVE operation at IC 7 and that a second sampling event with the SVE system shut down was warranted. Results from the May 1998 sampling event strongly suggest that minimal petroleum hydrocarbon contamination remains at PZ91 (all depths) and at VMP1 and VMP2 at depths greater than 30 feet bgs. The remaining petroleum hydrocarbon contamination in site soils appears to most significant in the vicinity of VMP1-17 where TPH-g concentrations of 37,000 ppmv and total BTEX concentrations of 469 ppmv were detected. Petroleum hydrocarbon concentrations also were somewhat elevated at VMP2-19.5. Petroleum hydrocarbon concentrations quickly dissipate with increasing depth as TPH-g and BTEX concentrations at VMP1-30 and VMP2-30 were approximately 3 orders of magnitude less than those measured at VMP1-17, and near non-detect concentrations were measured at VMP1-54 and VMP2-49.

DISCUSSION

March 1998 soil vapor sampling results indicate that vadose zone soils at Site ST200 are influenced by a vapor extraction well (VEW) at IC 7 which is located approximately 300 feet northwest of Site ST200. The VEW is reported as having a radius of influence of 400 feet (Soper, 1998). Based on these findings, if the bioventing system at Site ST200 is shut down, vadose zone soil treatment and oxygenation is likely to proceed with continued operation of the SVE system.

Soil vapor results from the May 1998 sampling event suggest that petroleum contamination in site soils has been substantially reduced as compared to pre-bioventing data and site soils will not benefit significantly from further air injection bioventing. At most locations, static oxygen concentrations are at, or near, atmospheric levels, and are sufficient to support aerobic biodegradation of any remaining soil contamination. Sample results indicate that oxygen concentrations generally are less than 5 percent and residual petroleum hydrocarbon contamination is greatest in soils near VMP1 and VMP2 between 17 and 30 feet bgs. Below the 40-foot depth interval, minimal petroleum contamination and high oxygen concentrations are evident. Previously measured soil sample results corroborate these findings as maximum petroleum hydrocarbon concentrations have been observed in soils between 15 and 35 feet bgs and TPH and total BTEX concentrations have not exceeded 30 milligrams per kilogram (mg/kg) and 0.3 mg/kg, respectively, below 35 feet bgs at any location (Parsons ES, 1998).

The presence of water in the 17-foot screened interval at VMP1 during the May 1998 sampling event suggests that the effectiveness of bioventing treatment at this location has been reduced. A water line leak appears to be the most likely cause of soil saturation at VMP1-17 because the site is paved, and infiltration of water from the surface should be minimal. While little contamination is evident in site soils below 40 feet bgs, the suspected water line leak should be investigated and repaired to minimize the potential for downward contaminant migration and to improve air permeability and soil treatment effectiveness of the nearby SVE system.

RECOMMENDATIONS

Based on the May 1998 soil vapor results, the added benefit of continued air injection bioventing is expected to be minimal and confirmation soil sampling in support of a NFI recommendation for SA 6 (as proposed in the SAP) is recommended with the following modifications.

- The first soil sample from each of four borings should be collected between 15 and 20 feet bgs based on the soil vapor concentrations detected at VMP1-17 (*The SAP proposed collecting the first soil sample at least 20 feet bgs*).

- After delineating the vertical extent of contamination near former soil boring IC06B006, proposed soil boring IC06B029 can be drilled to groundwater without further soil sampling in order to collect a Hydropunch® groundwater sample (*The SAP proposed soil sampling IC06B029 at 10-foot intervals until reaching groundwater*).

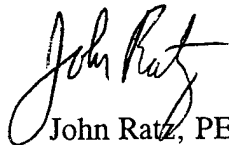
Soil vapor results suggest that soil sampling below 40 feet bgs is not warranted; however, the total depth of each soil boring will be determined based on multiple field observations which indicate the vertical extent of contamination has been adequately delineated. Confirmation sampling procedures are detailed further in the SAP (Parsons ES, 1998).

In addition, the presence of water at VMP1-17 suggests a water line leak may be present near this location and should be investigated by McClellan AFB.

We would appreciate receiving AFCEE, McClellan AFB, and California Regional Water Quality Control Board, Central Valley Division comments on this letter and recommendations herein by 21 August 1998. We plan on performing confirmation soil sampling activities in late August or early September 1998. If you have any questions or comments regarding the recommendations appearing in this report, please feel free to contact Mr. Michael Phelps at (510) 891-9085, or me at (303) 831-8100.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.



John Ratz, PE
Project Manager

cc: E. Marchand (AFCEE/ERT, Brooks AFB)
M. Phelps (Parsons ES - Oakland)
File 726876.36321.A

Attachments

REFERENCES

Parsons Engineering Science, Inc. (Parsons ES). 1998. Final Sampling and Analysis Plan to Support Recommendation for No Further Investigation at SA 6, McClellan Air Force Base, California. Oakland, California. February.

Soper, D. 1998. E-mail message to Marcus Pierce, Parsons ES, Oakland, California. 23 March.

TABLE 1
SUMMARY OF FIELD AND LABORATORY ANALYTICAL SOIL VAPOR RESULTS
SA 6
McCLELLAN AFB, CALIFORNIA

Sample Location	Depth (feet bgs) ^u	Sampling Event (Date)	Field-Screening Data				Laboratory Analytical Data ^u				
			Oxygen (percent)	Carbon Dioxide (percent)	TVH ^{bv} (ppmv) ^d	PID ^d (ppmv)	TPH-g ^d (ppmv)	Benzene (ppmv)	Toluene (ppmv)	Ethylbenzene (ppmv)	Xylenes (ppmv)
EW 279	25-100	Initial (8/93)	1.0	12.0	>10,000 ^d	2,600	14,000	130	140	9.4	130
		1-Year (9/94)	21.0	0.0	34	41.3	220	0.21	1.6	1.0	11
		4.5-Year (3/98) ^u	n.a. ^u	n.a.	n.a.	n.a.	---	---	---	---	---
		4.5-Year (5/98)	20.1	0.6	0	2.2	---	---	---	---	---
EW 280	15-100	Initial (7/93)	16.5	2.5	58	91	55	<0.004 ^u	0.13	0.051	0.35
		1-Year (9/94)	21.0	0.0	0	5.9	6.0	<0.002	0.033	0.022	0.096
		4.5-Year (3/98) ^u	n.a.	n.a.	n.a.	n.a.	---	---	---	---	---
		4.5-Year (5/98)	19.6	1.0	80	12.0	---	---	---	---	---
VMP1	17	Initial (8/93)	1.2	15.2	>10,000	292	130,000	490	320	34	170
		1-Year (9/94)	4.0	2.2	2,600	2,341	3,300	15	27	18	130
		4.5-Year (3/98) ^u	n.a.	n.a.	n.a.	n.a.	---	---	---	---	---
		4.5-Year (5/98)	NR ^u	NR	NR	NR	37,000	77	130	52	210
	30	Initial (8/93)	1.0	12.2	5,200	1,727	---	---	---	---	---
		1-Year (9/94)	16.9	0.5	0	10.9	---	---	---	---	---
		4.5-Year (3/98) ^u	n.a.	n.a.	n.a.	n.a.	1.6	0.034	0.16	0.056	0.23
		4.5-Year (5/98)	18.5	0.8	140	36.9	54	0.052	0.38	0.27	1.4
	54	Initial (8/93)	10.5	5.5	1,000	387	---	---	---	---	---
		1-Year (9/94)	21.0	0.0	0	8.0	---	---	---	---	---
		4.5-Year (3/98) ^u	n.a.	n.a.	n.a.	n.a.	1.3	<0.022	0.090	<0.022	0.10
		4.5-Year (5/98)	20.5	0.8	95	11.3	5.5 / 5.7 ^u	0.031 / 0.031	0.072 / 0.077	0.032 / 0.032	0.18 / 0.18
VMP2	19.5	Initial (8/93)	1.2	20.0	>10,000	682	---	---	---	---	---
		1-Year (9/94)	0.0	16.0	>10,000	434	---	---	---	---	---
		4.5-Year (3/98) ^u	n.a.	n.a.	n.a.	n.a.	2.4	0.058	0.15	0.043	0.25
		4.5-Year (5/98)	3.9	5.0	250	47.5	120 / 150	0.15 / 0.27	0.23 / 0.44	0.34 / 0.28	0.93 / 1.2
	30	Initial (8/93)	2.2	12.0	>10,000	968	---	---	---	---	---
		1-Year (9/94)	3.5	2.2	5,800	3,477	---	---	---	---	---
		4.5-Year (3/98) ^u	n.a.	n.a.	n.a.	n.a.	4.0	0.076	0.30	0.050	0.32
		4.5-Year (5/98)	6.4	4.4	160	20.0	34	0.27	1.0	0.21	1.0
	49	Initial (8/93)	3.0	9.2	5,400	1,448	---	---	---	---	---
		1-Year (9/94)	21.0	0.0	1,000	540	---	---	---	---	---
		4.5-Year (3/98) ^u	n.a.	n.a.	n.a.	n.a.	1.5	0.025	0.13	0.038	0.19
		4.5-Year (5/98)	20.0	0.7	60	0.2	8.8	0.021	0.057	<0.013	0.076
PZ91	24	Initial (7/93)	1.5	10.0	>10,000	n.a.	13,000	38	35	6.6	22
		1-Year (9/94)	13.2	2.9	300	248	68	0.11	0.33	0.20	2.0
		4.5-Year (3/98) ^u	n.a.	n.a.	n.a.	n.a.	1.4 / 1.0	0.026 / 0.016 ^u	0.13 / 0.082	0.038 / 0.027	0.19 / 0.14
		4.5-Year (5/98)	13.9	0.9	65	0.0	2.9	<0.027	0.027	<0.027	0.060

TABLE 1 (continued)
SUMMARY OF FIELD AND LABORATORY ANALYTICAL SOIL VAPOR RESULTS
SA 6
McClellan AFB, California

Sample Location	Depth (feet bgs) ^u	Sampling Event (Date)	Field-Screening Data				Laboratory Analytical Data ^f					
			Carbon			TVH ^u (ppmv) ^e	PID ^d (ppmv)	TPH-g ^e (ppmv)	Benzene (ppmv)	Toluene (ppmv)	Ethylbenzene (ppmv)	Xylenes (ppmv)
			Oxygen (percent)	Dioxide (percent)								
PZ91	37	Initial (8/93)	1.0	9.5	> 10,000	n.a.	---	---	---	---	---	---
		1-Year (9/94)	16.5	0.5	76	75.7	---	---	---	---	---	---
		4.5-Year (3/98) ^u	n.a.	n.a.	n.a.	n.a.	1.7	0.043	0.16	0.042	0.20	0.20
		4.5-Year (5/98)	18.5	1.1	70	0.0	3.5	<0.026	0.035	<0.026	0.097	0.097
	49	Initial (8/93)	3.0	7.2	3,400	n.a.	---	---	---	---	---	---
		1-Year (9/94)	19.9	0.0	58	62.5	---	---	---	---	---	---
		4.5-Year (3/98) ^u	n.a.	n.a.	n.a.	n.a.	1.2	<0.025	0.10	0.028	0.13	0.13
		4.5-Year (5/98)	20.0	0.8	75	0.0	2.8	<0.026	0.030	<0.026	0.059	0.059
	57	Initial (8/93)	1.5	7.0	900	n.a.	---	---	---	---	---	---
		1-Year (9/94)	20.5	0.0	35	799	---	---	---	---	---	---
		4.5-Year (3/98) ^u	n.a.	n.a.	n.a.	n.a.	3.2	0.060	0.30	0.088	0.39	0.39
		4.5-Year (5/98)	20.1	0.7	70	0.0	0.83	<0.026	<0.026	<0.026	0.027	0.027
	75	Initial (8/93)	3.0	7.8	73	n.a.	---	---	---	---	---	---
		1-Year (9/94)	20.5	0.0	40	46.0	---	---	---	---	---	---
		4.5-Year (3/98) ^u	n.a.	n.a.	n.a.	n.a.	3.3	0.052	0.25	0.084	0.37	0.37
		4.5-Year (5/98)	20.7	0.6	60	0.0	0.99	<0.025	0.039	<0.025	0.041	0.041
	99	Initial (8/93)	3.2	4.8	75	n.a.	---	---	---	---	---	---
		1-Year (9/94)	20.5	0.0	26	34.4	---	---	---	---	---	---
		4.5-Year (3/98) ^u	n.a.	n.a.	n.a.	n.a.	3.4	0.038	0.19	0.052	0.24	0.24
		4.5-Year (5/98)	20.0	0.9	90	2.9	2.2	<0.026	<0.026	<0.026	0.055	0.055

^{a/} ft bgs = feet below ground surface.

^{b/} TVH = Total volatile hydrocarbons.

^{c/} ppmv = Parts per million, volume per volume.

^{d/} PID = Photoionization detector results quantifying ionizable compounds.

^{e/} TPH-g = Total petroleum hydrocarbons (hydrocarbons with 2 or more carbon rings) referenced to gasoline.

^{f/} Laboratory analysis of soil gas by USEPA Method TO-3.

^{g/} > = Concentration greater than maximum reading on field instrument.

^{h/} SVE system at adjacent site was operating during the March 1998 sampling event influencing soil vapor results.

^{i/} n.a. = Not available.

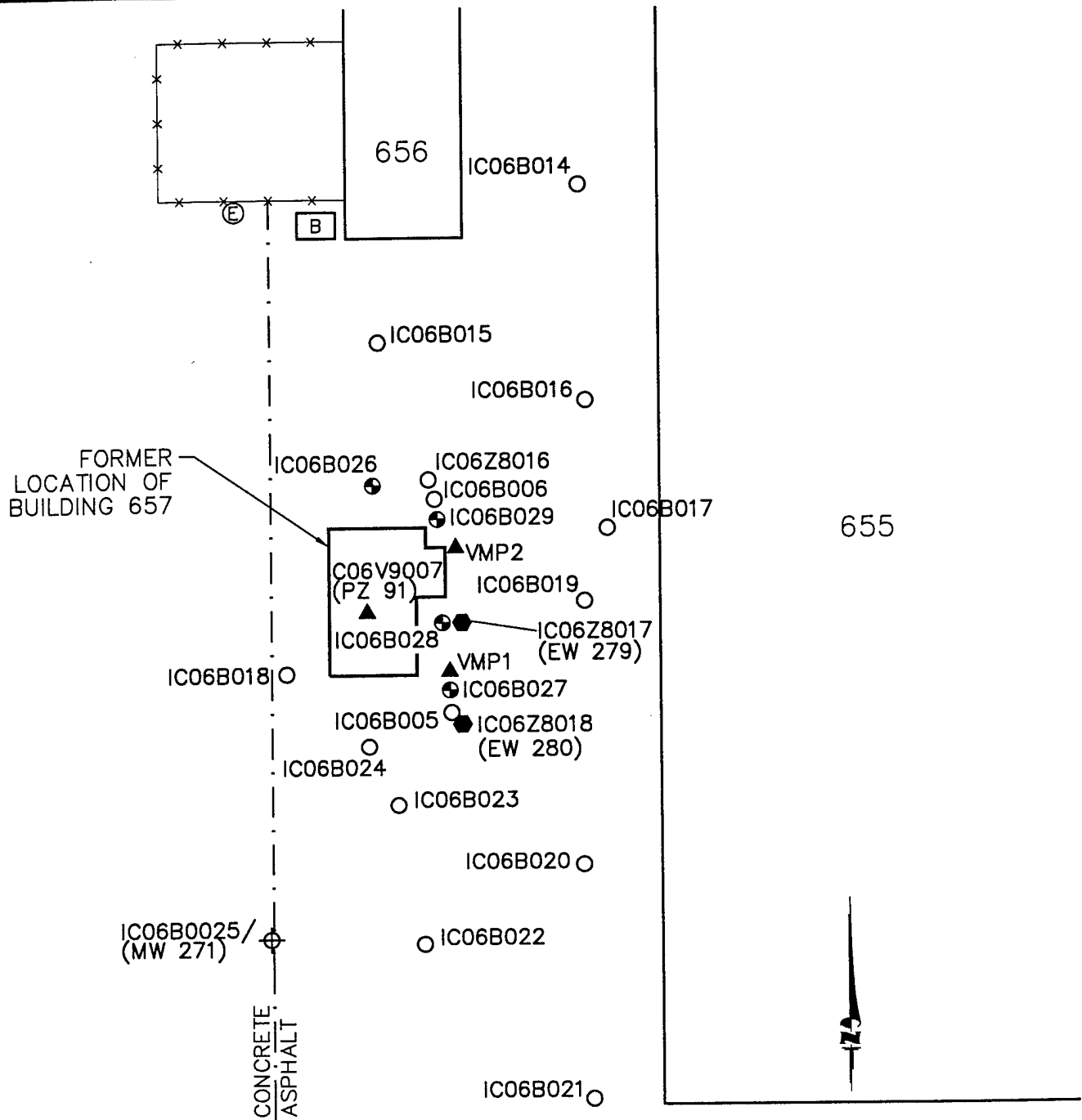
^{j/} --- = Not analyzed.

^{k/} < = Compound analyzed for, but not detected. Number shown represents the laboratory reporting limit.

^{l/} NR = No readings; monitoring point screened interval produced water during field measurements.

^{m/} Original sample result/duplicate result.

^{n/} J = Analyte detected, but below the laboratory reporting limit. Number shown is a laboratory estimate.



LEGEND

- 656 BUILDING
- CONCRETE/ASPHALT BORDER
- IC06B026 PROPOSED SOIL BORING
- IC06B022 PREVIOUS SOIL BORING
- EW 279 EXISTING VENT WELL
- ▲ VMP1 EXISTING VAPOR MONITORING POINT (PIEZOMETER)
- ⊕ MW-271 GROUNDWATER MONITORING WELL
- x - x - x - FENCE



FIGURE 1

PROPOSED CONFIRMATION SOIL SAMPLING LOCATIONS

SA 6
McClellan AFB, California

**PARSONS
ENGINEERING SCIENCE, INC.**

Denver, Colorado